REMARKS/ARGUMENTS

The office action of October 21, 2004 has been carefully reviewed and these remarks are responsive thereto. Reconsideration and allowance of the instant application are respectfully requested. Claims 1, 4, 6-8, and 12-16 are pending. Claims 1, 4, 7, and 8 are amended. Claims 12-16 are new. Claims 2, 3, 5, and 9-11 are canceled.

The main object of the claimed invention is to develop images of a bone structure by magnetic resonance imaging (MRI). MRI has been conventionally used to obtain images of the brain. A radiation-free method, MRI does not require any special abilities or requirements of the operator.

As recited in the amended claims, the present invention obtains an MRI image using a magnetic longitudinal relaxation measurement (T1 measurement) and a magnetic transverse relaxation measurement (T2 measurement) respectively. The MRI image obtained by the T1 measurement is three-dimensionally aligned with the MRI image obtained by the T2 measurement.

A spectral intensity value with respect to one of the MRI image by the T1 measurement and the MRI image by the T2 measurement is obtained at the same position as a predetermined position of another of the MRI image by the T1 measurement and the MRI image by the T2 measurement by interpolation. A new image (showing the bone structure) is obtained by linear calculation.

Since the claimed invention obtains the bone image by linear calculation of the images by T1 and T2 (and image by PD (proton density), if necessary), processing at a far higher speed can be realized compared to a case where a complicated processing is required for obtaining the image. The prior art, alone or in combination, does not teach or suggest the claimed invention.

Claims 1-8 and 10-11 stand rejected under 35 U.S.C. 102(b) as being anticipated by Reiderman et al. (U.S. Patent No. 6,278,891). Reiderman is cited for teaching that an image of the actual human bone is producible with the combined technique using "any suitable image developing technique known in the art".

Claim 1 has been amended to recite obtaining magnetic resonance imaging image information as a set of the magnetic resonance spectral intensity values measured at the measuring point by *two kinds* of spectral intensity measuring methods respectively with respect to the object to be measured, the spectral intensity measuring methods comprising a magnetic longitudinal relaxation measurement and a magnetic transverse relaxation measurement. Claim 1 was further amended to recite three-dimensionally aligning the magnetic resonance imaging image information obtained by the magnetic longitudinal relaxation measurement with the magnetic resonance imaging image information obtained by the magnetic transverse relaxation measurement. Claim 1 further recites deriving information showing a bone structure as new image information by linear calculation between the spectral intensity value obtained by the magnetic longitudinal relaxation measurement and the spectral intensity value obtained by the magnetic transverse relaxation measurement at each of the measuring points

Reiderman does not teach or suggest obtaining a bone image using a magnetic longitudinal relaxation measurement (T1 measurement) and a magnetic transverse relaxation measurement (T2 measurement) respectively and three-dimensionally aligning the MRI image obtained by the T1 measurement with the MRI image obtained by the T2 measurement in accordance with claim 1. Withdrawal of this rejection is requested.

Claims 1, 2, 5, 6 and 7 stand rejected under 35 U.S.C. 102(b) as being anticipated by Traicher et al. (U.S. Patent No. 6,285,901). Claim 1 has been amended to recite at least the limitation of claim 3. Claim 3 was not included in this rejection; hence the rejection is moot and should be withdrawn.

Claim 9 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Reiderman et al. as applied to claims 1-8, 10 and 11 and in further view of Giger et al. (U.S. Patent No. 5,974,165).

Claim 1 has been amended to recite the limitation of claim 9 and accordingly claim 9 has been canceled. Reiderman does not teach or suggest the describe claim 1 for the reasons

identified above and hereby incorporated by reference. Giger does not remedy the defects of Reiderman.

Giger merely discloses that NMR/MRI images are combined with x-ray CT images to obtain a chest image. Giger does not teach or suggest obtaining a bone image using a magnetic longitudinal relaxation measurement (T1 measurement) and a magnetic transverse relaxation measurement (T2 measurement) respectively and three-dimensionally aligning the MRI image obtained by the T1 measurement with the MRI image obtained by the T2 measurement in accordance with claim 1. Reiderman in view of Giger does not teach or suggest the claimed invention. Withdrawal of this rejection is requested.

Claims 1-11 stand rejected under 35 U.S.C. 102(f) as allegedly the applicant did not invent the claimed subject matter. This rejection is based on a Japanese article. As admitted by on page 2 of the Office Action, the document was not considered because it is not in English. Thus, this rejection is based on mere speculation and is improper. Attached is an English-language version of the article which shows that the document merely shows the state of the art, i.e. the known use of MRI and X-ray CT for determining brain function. The article is also discussed in the Background section of the instant application. See page 2 of the specification. Withdrawal of this rejection is requested.

CONCLUSION

In view of the above amendments and remarks, withdrawal of the rejections and issuance of a Notice of Allowance is requested.

Respectfully submitted,

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Dated: January 18, 2005

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Research of Structural Image Process for Optical Brain Function Measurement

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1. Introduction

In recent years, research of the brain functional imaging equipment using light is prosperous. However, since light is strongly scattered by a bone, the image of the bone by X-ray CT will become very important for the brain activity measurement by light. Since we considered structural image processing for the purpose of using the structural image of the head by MRI and X-ray CT effective in brain functional research, we report this time.

2. Signal Intensity of X-ray CT and MRI image

The scale usually called CT value is used for the X ray CT image. CT value and the linear absorption coefficient μ of each voxel have the relation of equation (1).

$$\text{CT value}=K(\mu-\mu\omega)/\ \mu\omega \qquad (1)$$

$\mu\omega$ expresses the linear absorption coefficient of water here, and K is a constant. A K-value is 1000 and is called a Hounsfield unit. This serves as a scale which set CT value of water to 0 and set CT value of air to -1000, as shown in equation (1). Although a bone changes with calcium contents, it will have high CT value of about +1000. By an MRI image, when the signal intensity of pixel is 16bit without a mark, the values from 0 to 65536 (16th power of 2) can be taken. However, since bony MRI signal intensity is small, by an MRI image, it is hard to check a bone.

Table 1 explains the image intensity about X-ray CT, T1 weighted image used as an MRI structural image, and the T2* weighted image used for a functional image.

Table 1. Organization and image intensity

	X-ray	MRI(T1)	MRI(T2*)
Water	0	Low	High
Bone	+1000	Low	Low
Brain	50	A little high, middle	Middle, a little high
Skin	90	Middle	A little high

3. Measurement Method of Head by X-ray CT and MRI

In the same subject, the same part was picturized through X-ray CT and MRI, respectively. The obtained images were captured into the Windows machine in DICOM form, and it changed into 2D and 3D form using MRIcro of free software etc. Those images were displayed and comparison examination was carried out. Moreover, since the same part needed to be picturized, the marker common to X-ray CT and MRI was produced, and improvement in posture reappearance was aimed at.

4. Skull Measurement Result by X-ray CT

The bony light scattering property is the largest in a living body. Therefore, when a bony position and thickness differ from each other greatly, it is possible that a difference arises in the sensitivity of the brain measurement using light.

The form of a skull changes a lot especially near inion (external occipital protuberance) of the back of the head. Therefore, in measuring near inion with light, cautions are required. The X ray image of the head section containing inion is shown in Fig. 1. In respect of the slice of the upper part of this section, and the lower part, bone form completely differs.

The variation in the bone thickness by the place of a forehead is shown in Fig. 2. In the forehead, about 5mm variation is in the thickness of a skull at the maximum by a place.

Fig. 1. X ray image of section containing inion

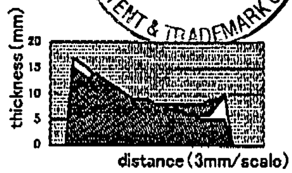

Fig. 2. Bone thickness of forehead

5. Conclusion

Since X-ray CT hardly spread through the brain functional facilities for research which do not perform clinical, they have little amount of information about a skull in the brain functional facilities for research. On the other hand, since X-ray CT have spread extremely compared with MRI actually, an X-ray CT image precedes overwhelmingly in many cases. It is expectable to use a structure image for brain functional research effectively by combining the point which was excellent in the X-ray CT image and the MRI image from now on.